High-rise Passive House in NYC

By Lisa DiCaprio, Conservation Chair, Sierra Club NYC Group

NYC is leading in high-rise Passive House design and construction. On November 1, 2017, the Passive House Institute certified the 26-story Passive House residential building on the Cornell Tech campus on Roosevelt Island, which is now the largest and tallest Passive House building in the world. Handel Architects, based in NYC, designed the building. [1]

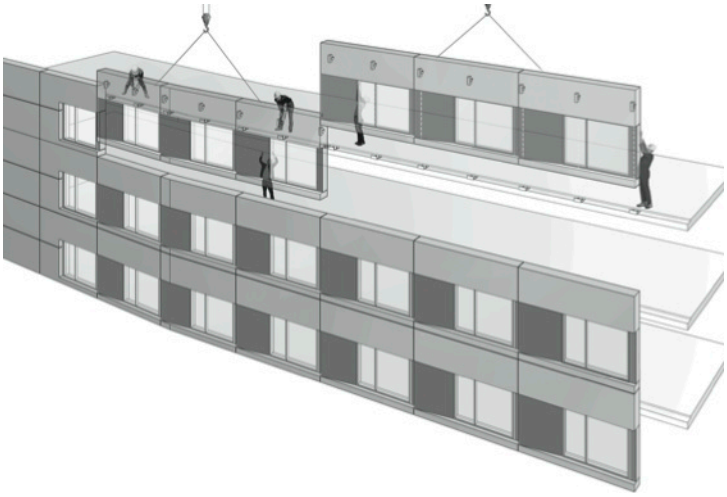

Photo Courtesy of Handel Architects

The world's first Passive House high-rise, the 21-story Raiffeisen office tower in Vienna, was completed in 2012.[2] A 28-story residential building is now in progress in Bilbao, Spain.[3] In 2017, the NYC government selected Handel Architects to design a 37-story, all-affordable Passive House apartment building on city property in East Harlem.[4] These high-rise projects represent a new phase in Passive House construction, which is crucial — buildings are now responsible for 40% of global greenhouse gas emissions and two-thirds of the world's population is predicted to live in cities by 2050.

Passive House is an international building efficiency standard, developed by the Passive House Institute in Darmstadt, Germany, that saves up to 90% of the energy required for heating and cooling conventional buildings and 75% of all energy usage when electricity is included in the total. The first Passive House building was built in Darmstadt in 1991.

Passive House certification requires meeting criteria in three main areas: (1) use of energy per square foot per year, (2) external air and fresh air ventilation must be balanced with energy recovery and (3) air tightness, as measured by the number of air changes per hour through the building façade.[5]

Since 2015, the Passive House Standard has included three certification options: Passive House Classic is the traditional standard, Passive House Plus requires the on-site generation of energy from renewable sources to equal consumption over a one year period, and Passive House Premium, for which the on-site generation of renewable energy must exceed its consumption, also on an annual basis.[6]

Currently, Passive House construction is somewhat more expensive than conventional buildings. The higher upfront costs, which are made up within a relatively short period of time because of reduced maintenance expenses, will decrease in the future as Passive House is scaled up throughout the world and new materials are developed to meet its specifications.

The Passive House residential building on the Cornell Tech campus provides 352 apartments for students and faculty. Cornell Tech is an initiative of former NYC Mayor Michael Bloomberg and will grant graduate degrees in Applied Sciences. The innovative 12-acre campus, which is being built in three phases, opened in September with the residential building (The House); the Bloomberg Center, a Net-Zero Energy four-story academic building with 1,464 solar

panels and 80 geothermal wells; and the Bridge, a LEED Silver building with a rooftop solar photovoltaic canopy, that will bring together technology companies and academic research teams.[7]

Photo Courtesy of Handel Architects

In February 2017, I participated in a group tour of the Passive House residential building that was led by Deborah Moelis, AIA CPHD (Certified Passive House Designer), Senior Associate and founding member of Handel Architects and the Project Architect. This tour, which included a completed apartment, gave me an opportunity to view key features of the building.

- The location faces south on Roosevelt Island in NYC's East River.
- The building's compact shape has a high ratio of interior to exterior area.
- A solar canopy at the southern façade shades the lobby.
- The building enclosure, which wraps around the building, is a prefabricated panelized wall system. Each 9'2" x 36' panel is comprised of metal, windows and non-combustible mineral wool insulation. Factory assembly of these panels ensures superior quality control and reduces the time and expense required for field construction. (The façade is 23% glass.)
- Strategies for eliminating thermal bridging (heat loss from the building), such as separating the metal panel from the exterior sheathing with thermally broken clips.
- High-performance, triple-glazed windows.
- The louver, which runs along the entire height of the southwest façade of the building, provides ventilated exterior spaces on each floor to house the condenser units that condition the variable refrigerant flow (VRF) for the heating and cooling system.
- The refrigerant flows to the evaporators in each living room and bedroom, allowing residents to adjust room temperature. Windows in all rooms can be opened.
- The apartments are equipped with Energy Star appliances and efficient lighting.
- Two energy-recovery ventilation (ERV) units on the rooftop. Each unit extracts heat from the exhaust air pulled from the apartment exhaust ducts. This heat is then transferred to the incoming fresh air before it is carried to the apartments through separate fresh air ducts. Fresh filtered air is delivered to each living room and bedroom. By contrast, in a conventional building, warm air escapes from the walls, windows and doors, and cold, fresh air must be constantly heated with a boiler or furnace.[8]

Passive House construction is gaining momentum in NYC and now includes a variety of residential and institutional buildings.[9] The energy efficiency of Passive House design can also facilitate the construction of affordable housing because it reduces the subsidies required for operational expenses. In NYC, Passive House all-affordable housing developments include the project to be built in East Harlem and a 24-story building in the Bronx designed by Dattner Architects.[10]

Several factors are facilitating Passive House buildings in NYC. These include:

- **NYC's goal to reduce greenhouse gas emissions by 80% by 2050 and the essential role of green building design in meeting this goal.** Buildings are responsible for 67% of these emissions in NYC, as reported in the greenhouse gas emissions inventory completed in 2017. Mayor Bill de Blasio's 2014 report, *One City Built to Last: Transforming New York City's Buildings for a Low Carbon Future*, which focuses on how to reduce emissions from NYC buildings, specifically mentions Passive House design.[11]
- **NYC City Council legislation and initiatives to increase the energy efficiency required for new and existing buildings.** For example, the City Council has passed bills to require all NYC-owned new buildings and all large new and substantially retrofitted buildings in NYC to be designed and constructed as low-energy-intensity buildings.[12] In the future, this legislation could be modified to require Passive House certification, especially given the successful completion of high-rise Passive House buildings throughout the world.
- **Advocacy by Passive House architects,** which has created public awareness about the environmental and public health benefits of this design, such as the annual International Passive House Conference,[13] the North American Passive House Network[14] and NY Passive House (NYPH), which organizes workshops, events, building tours, workshops and classes on NYC building codes and Passive House design, and an annual New York

Passive House Conference and Expo.[15] Passive House architects participated in the September 2014 People's Climate March in NYC with the banner, "Passive House: Low Carbon by Design."

- **Architects Advocate Action on Climate Change,** a network of architectural firms that highlights the role of architects in promoting sustainability.[16]
- **Promotion of Passive House by environmental organizations.** For example, in December 2016, the Sierra Club NYC Group Sustainability Series featured a program on Passive House that I helped to organize, at which architect Deborah Moelis spoke about the Cornell Tech residential building. Ray Sage, a contractor and consultant, and Wendy Brawer, a designer, discussed a row house in Brooklyn that is the first Passive House and Net-Zero-capable building certified in NYC.[17]
- **An increase in the number of Passive House-certified architects, consultants and tradespeople** with experience in Passive House construction.
- **Feasibility studies for high-rise Passive House buildings,** such as the 2017 study by FXFOWLE Architects on tall, Passive House residential buildings, which was funded by the New York State Energy Research and Development Authority (NYSERDA).[18]
- **Innovations in Passive House design** and the various building materials required to meet Passive House specifications.[19]
- **Advocacy by NYC borough presidents for Passive House buildings in NYC.** For example, resolutions passed in April 2016 by the Manhattan Borough Board, chaired by Borough President Gale Brewer,[20] and in April 2017 by the Brooklyn Borough Board, chaired by Borough President Eric Adams.[21]
- On the federal level, the **White House Passive House Initiative** launched by President Obama in 2015 included a new, Passive House track for New York State Homes and Community Renewable (HCR), which was to work with NYSERDA to promote Passive House design for affordable, multifamily buildings.[22]

We can also advocate for Passive House by considering the social cost of carbon in calculating the cost of construction. This key environmental concept, which has been utilized by the EPA, assigns a monetary value to the social cost of climate-change impacts caused by carbon pollution that are now affecting all sectors of the global economy.

The NYC City Council has incorporated the social cost of carbon in two renewable energy bills: Int. 1159–2016, on the installation of solar water heating and thermal energy systems on city-owned buildings, and Int. 0609A–2015, concerning the installation of geothermal systems on city-owned buildings. The geothermal bill set the social cost of carbon at $128 per metric ton of carbon dioxide equivalent (CO_2e) with progressively increasing values that reach $142 per metric ton by 2020.[23]

Applying the social cost of carbon to a building means assigning a specific dollar amount for each metric ton of CO_2e that the building does *not* emit because of its low-carbon design. This valuation, which could be increased every five years, would be multiplied by the number of years projected for the life of the building.

For example, the Passive House residential building on the Cornell Tech campus will save 882 metric tons of emissions per year.[24] Multiplying 882 x $128, the social cost of carbon that it saves during one year is $112,896. Even if we do not progressively increase the $128 cost per metric ton, the social cost of carbon saved over an assumed 100-year life span for the building would be $11,289,600. This is about one-tenth of the building's approximate $115 million cost, an environmental saving that exceeds the somewhat higher, upfront costs of its Passive House design. Moreover, the environmental benefits of Passive House buildings will increase in the future as they become less expensive and the cost of climate change accelerates.

While the Trump administration denies the science of climate change, Passive House architects and engineers are applying the science of buildings to achieve increasingly ambitious energy efficiency standards. Now more than ever, this is the time for a new, national Sierra Club initiative to promote Passive House design throughout the U.S.

KEY RESOURCES:

- The Handel Architects websites on the Passive House high-rise residential building on the Cornell Tech campus
  - See here for more info on the Passive House at Cornell Tech
- The Cornell Tech website
- The New York Passive House website
- The April 2016 Manhattan Borough Board resolution in support of Passive House construction in NYC can serve as a model for promoting Passive House in cities, universities and states

Notes:

[1] See the Handel Architects website, Cornell Tech is Open! The Passive House Institute also contributes to the maintenance of an international database of Passive House buildings. See: http://passivehouse-database.org/index.php?lang=en#d_5233
[2] See: https://www.b2match.eu/system/building2016/files/Raiffeisen_Hochhaus.pdf?1461650687; Vienna also has a Eurogate district comprised entirely of Passive House buildings. See: http://www.buildup.eu/en/practices/cases/world-largest-passive-house-settlement-eurogate-started-vienna-austria
[3] See: https://blog.passivehouse-international.org/aiming-high-passive-house-high-rise-buildings
[4] See the Handel Architects website for a description of the Sendero Verde (green pathway) Passive House apartment building: http://www.handelarchitects.com/projects/type/residential/sendero-verde-residential.html and the NYC Housing Preservation and Development (HPD) and NYC Housing Development Corporation (HDC) February 7, 2017 press release about the East Harlem development project.
[5] Specifically, the blower door test, carried out at 50 pascals of air pressure, cannot exceed .6 air changes per hour (ACH). This is ten times the air tightness of a conventional building which typically has 6 to 8 ACH. The Cornell Tech Passive House residential building has an air tightness of .15 ACH, which substantially exceeds the Passive House requirement.
[6] See: www.passivehouse.com and Christina B. Farnsworth, "Passive House Options Now Include Classic, Plus and Premium," posted March 21, 2015 on the Building Science website. A renovated townhouse in Carroll Gardens, Brooklyn is the first Passive House Plus certified building in the U.S. See: https://www.nypassivehouse.org/project/first-passive-house-plus-certified-in-the-u-s
[7] See the Cornell Tech website: https://tech.cornell.edu/campus
[8] For a description and visuals of these features, see the Handel Architects website, Designing and Building the World's Largest & Tallest Passive House Building.
[9] Alison Gregor,"The Passive House in New York," New York Times, March 29, 2015. Several additional Passive House retrofits and new Passive House buildings have been constructed since the publication of this article. For updates, see: https://www.nypassivehouse.org.
[10] For the project in Mott Haven, Bronx, see, Tanav Warerkar, "NYC's Largest Residential Passive House Will Rise in Mott Haven," April 29, 2016, Curbed New York and the website of Dattner Architects which is designing the building: http://www.dattner.com/portfolio/425-grand-concourse-passive-house-development
[11] For One City Built to Last, see the NYC Office of the Mayor's September 21, 2014 press release and the One City Built to Last website for the complete report.
[12] For the texts of these City Council bills, see: Int. 0701-2015 and Int. 1629- 2017.
[13] The theme of this year's 21st annual International Passive House Conference was "Passive House for All."
[14] See: http://naphnetwork.org
[15] See: https://www.nypassivehouse.org
[16] See: http://www.architects-advocate.com
[17] The R-951 Residence in Brooklyn is a Passive House row house with three apartments. See: http://www.r-951.com
[18] For "The Feasibility Study to Implement the Passivhaus Standard in Tall Residential Buildings," see: https://www.nypassivehouse.org/passivhaus-feasibility-study-released and, http://www.fxfowle.com/projects/182/feasibility-study-to-implement-the-passivhaus-standard-on-tall-residential-buildings
[19] For example, the 2017 New York Passive House Conference and Expo featured booths with several companies producing building materials for Passive House. See: https://www.nypassivehouse.org/expo
[20] See: http://manhattanbp.nyc.gov/downloads/pdf/Final%20Passive%20House%20Borough%20Board%20Resolution.pdf
[21] See: https://www.nypassivehouse.org/brooklyn-borough-president-highlights-broad-support-for-implementation-of-passive-house-design
[22] See: https://www.nypassivehouse.org/white-house-announces-passive-house-initiative
[23] For the incorporation of the social cost of carbon in the geothermal bill, see Int. 0609A-2015. For an explanation of the social cost of carbon, see: Michael Greenstone and Cass R. Susskind, "Donald Trump Should Know This is What Climate Change Costs Us," New York Times, December 15, 2016
[24] See: http://www.handelarchitects.com/projects/type/residential/cornell-res-residential.html

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